



**INTERNATIONAL CIVIL AVIATION ORGANIZATION**  
A United Nations Specialized Agency



# **PBN Flight Procedure Design Workshop** **for NON-DESIGNERS** **(online)**

## **STAR&SID**

**(4-5/Feb/2026)**



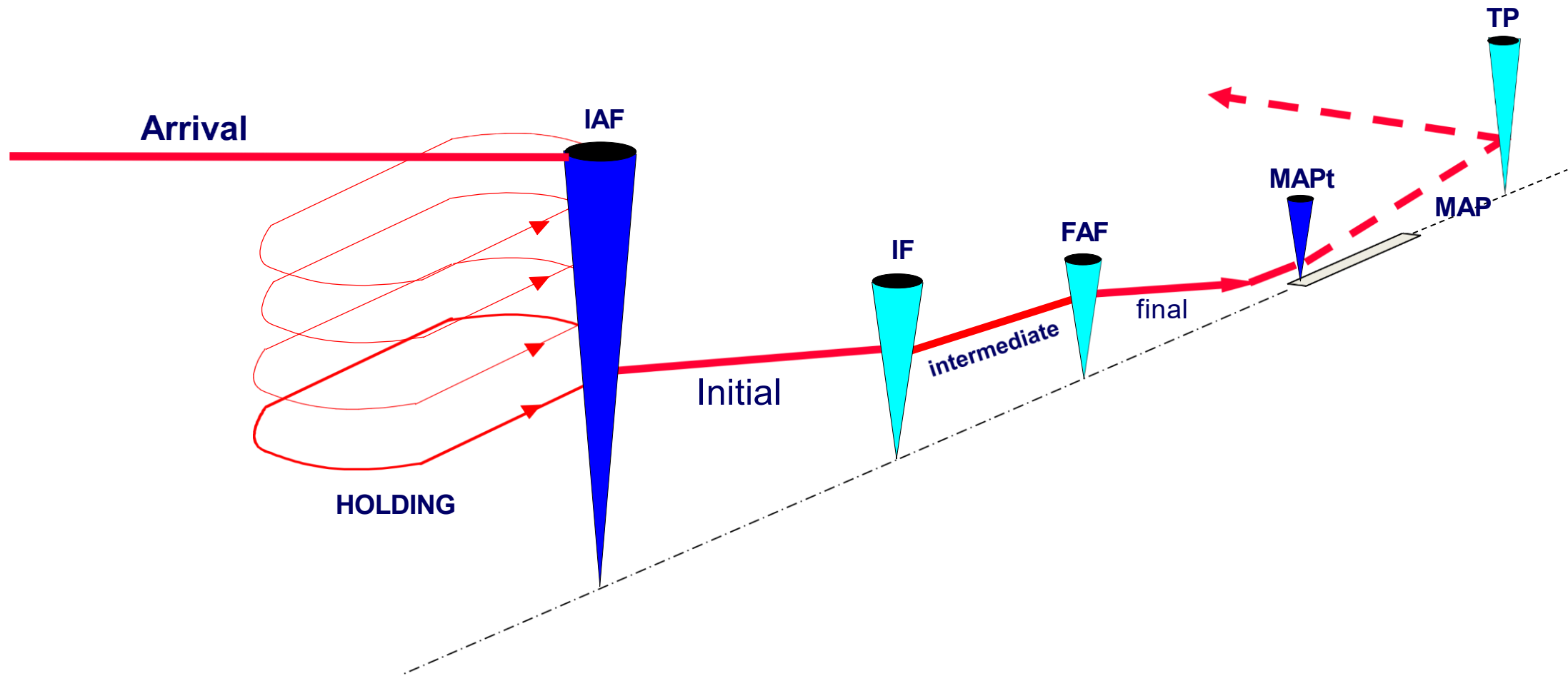


# PBN STAR Concepts

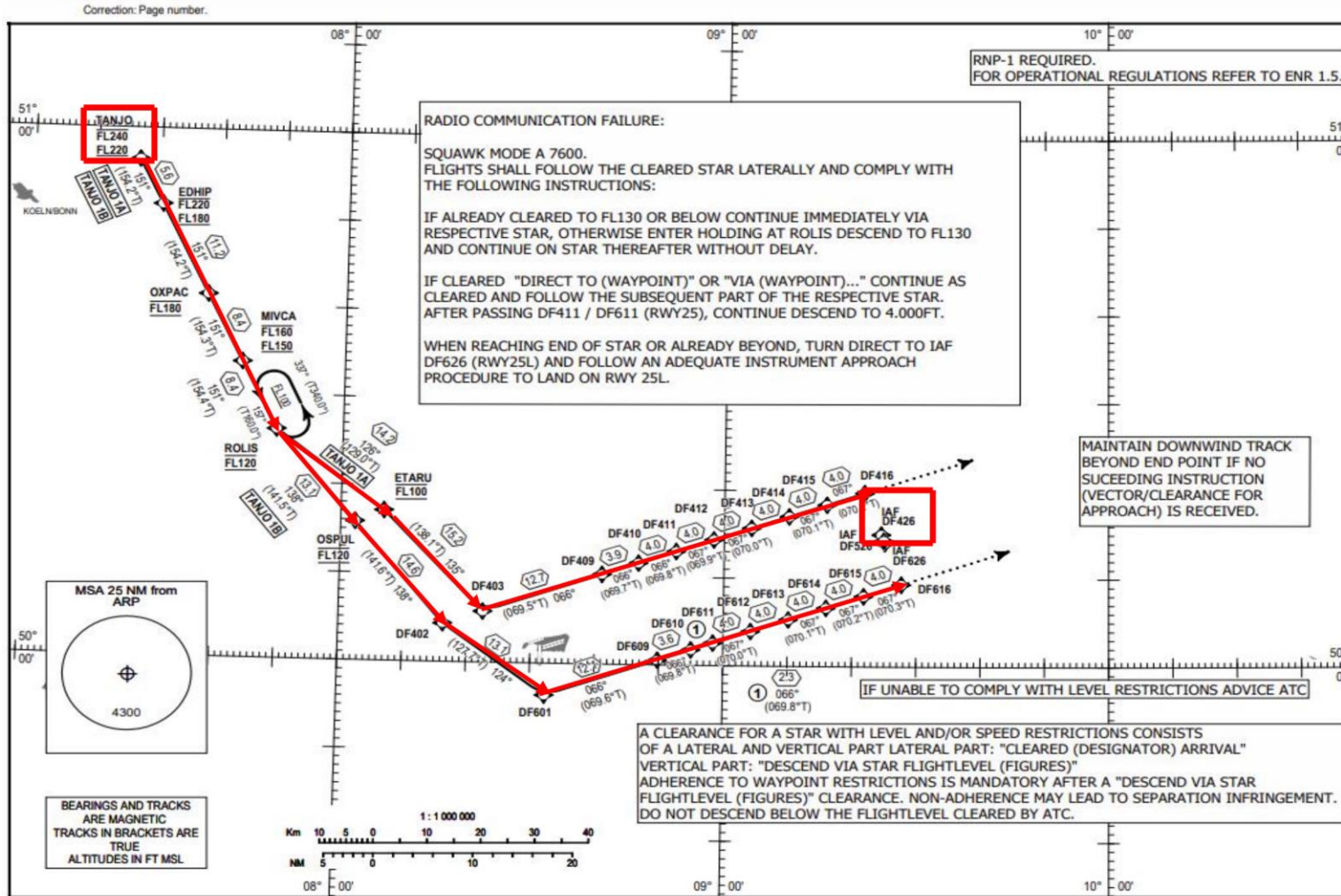
# Standard Arrival

- Standard Instrument Arrival (STAR)
  - It links and provides a smooth transition from en-route to approach segments.
  - A STAR should be simple and easily understood;
  - A STAR may serve one or more airports within a terminal area.
  - Procedure design should consider the environmental and efficiency advantages afforded by implementation of a continuous descent operation(CDO).

# Standard Arrival



# Standard Arrival



AD 2 EDDF-3-1-113  
 Effective: 02 NOV 2023

FRANKFURT MAIN  
 RWY 25L/25C/25R  
 TANJO 1A/1B

FRANKFURT ATIS 118.030  
 LANGEN RADAR 120.805  
 LANGEN RADAR 125.365

TRANSITION ALTITUDE 5000  
 VAR 3° E

LUFTHANDBUCH DEUTSCHLAND  
 AIP GERMANY

STANDARD ARRIVAL CHART - INSTRUMENT RNP



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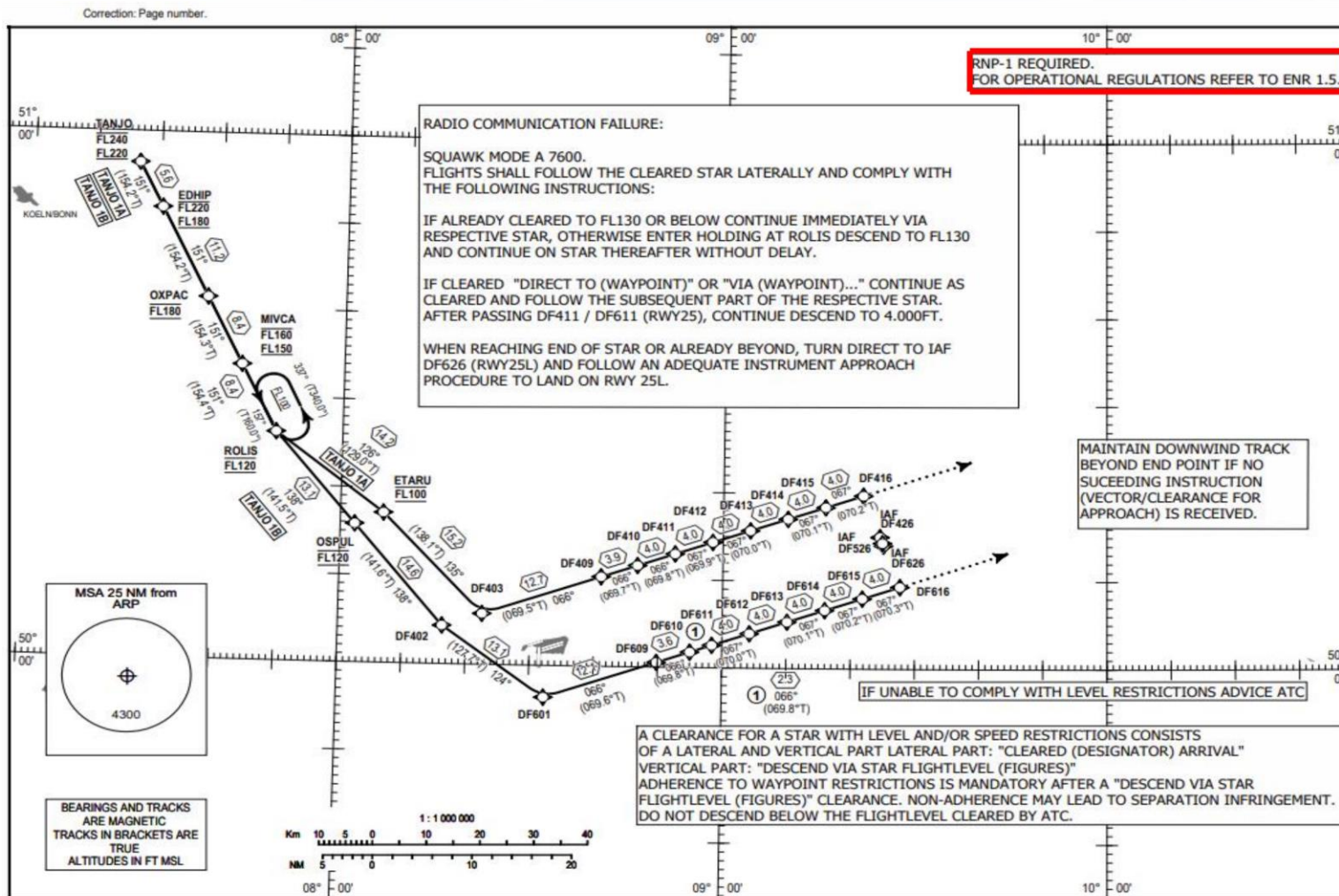
# PBN STAR Navigation Specifications

# STAR Navigation Specifications

The navigation specifications could be used are as follows:

- RNP 1;
- RNAV 1;
- RNAV 2;

# STAR Navigation Specifications



AD 2 EDDF 3-1-113  
Effective: 02 NOV 2023

FRANKFURT MAIN  
RWY 25L/25C/25R  
TANJO 1A/1B

FRANKFURT ATIS 118.030  
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CHART - INSTRUMENT  
RNP



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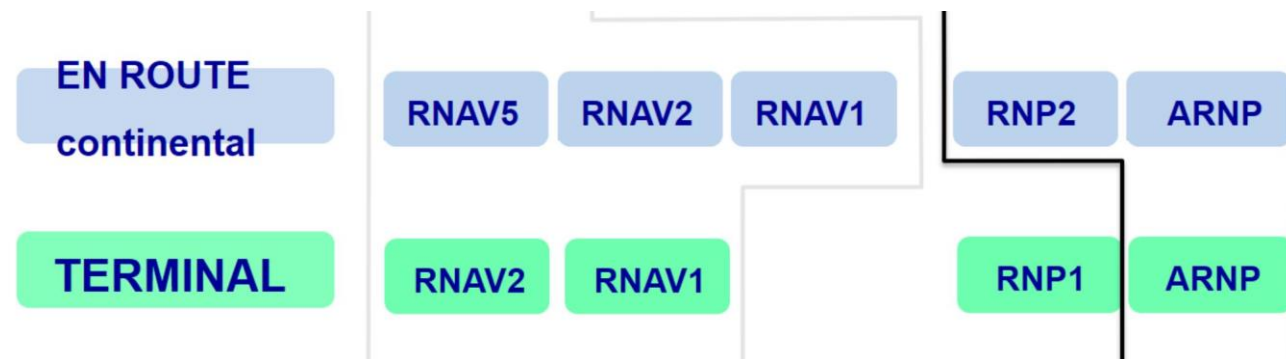


# PBN STAR Protection Area

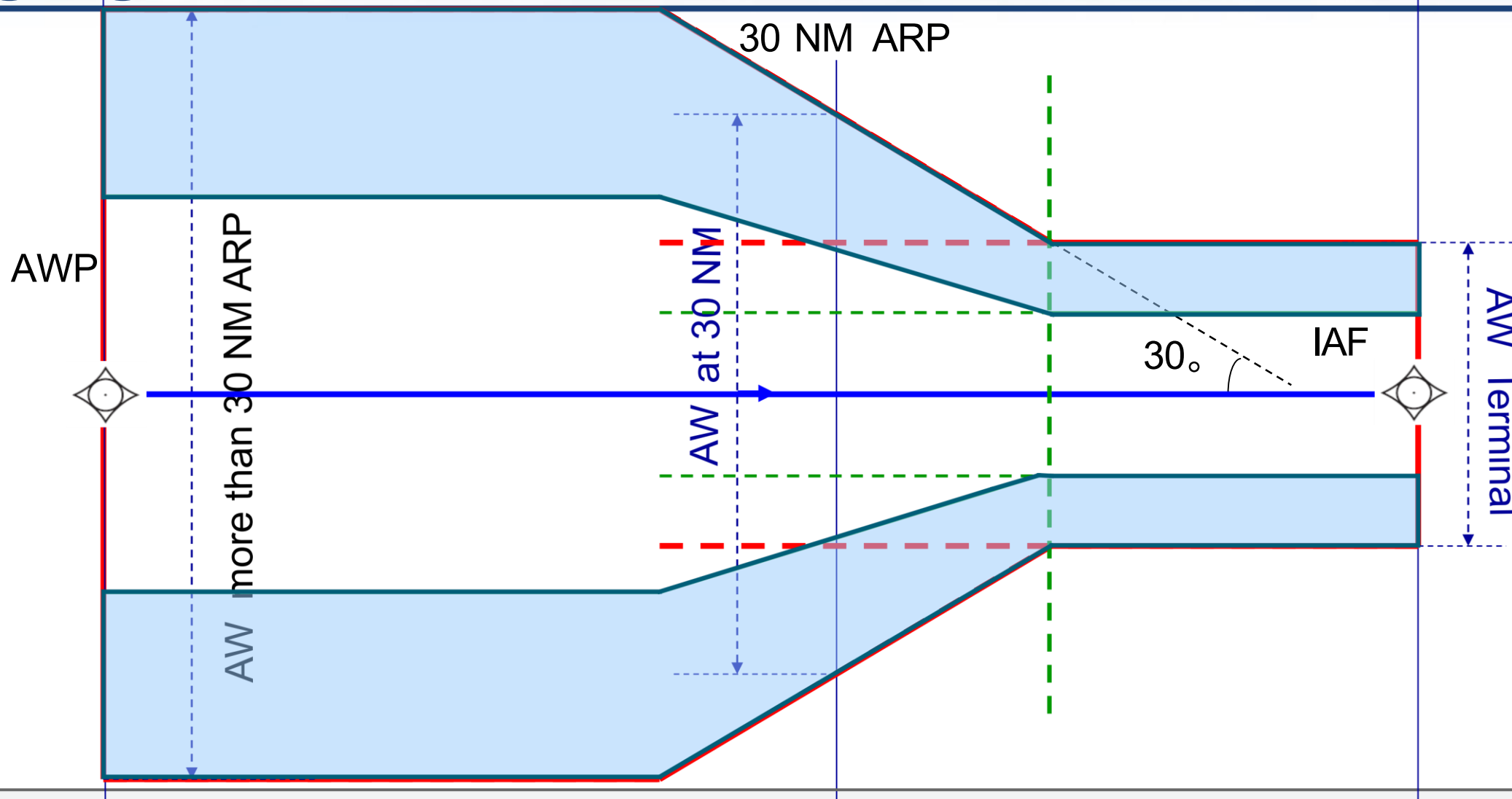
# Protection Area

## RNAV STAR

- Change at 30 NM from ARP
- Calculate area width at 30 NM. using
- XTT of subsequent segment
- BV of en-route phase
- XTT value: according to **navigation specification**
- BV of fight segment
- Semi- Area Width calculation:  $1/2 A/W = 1.5 XTT + BV$



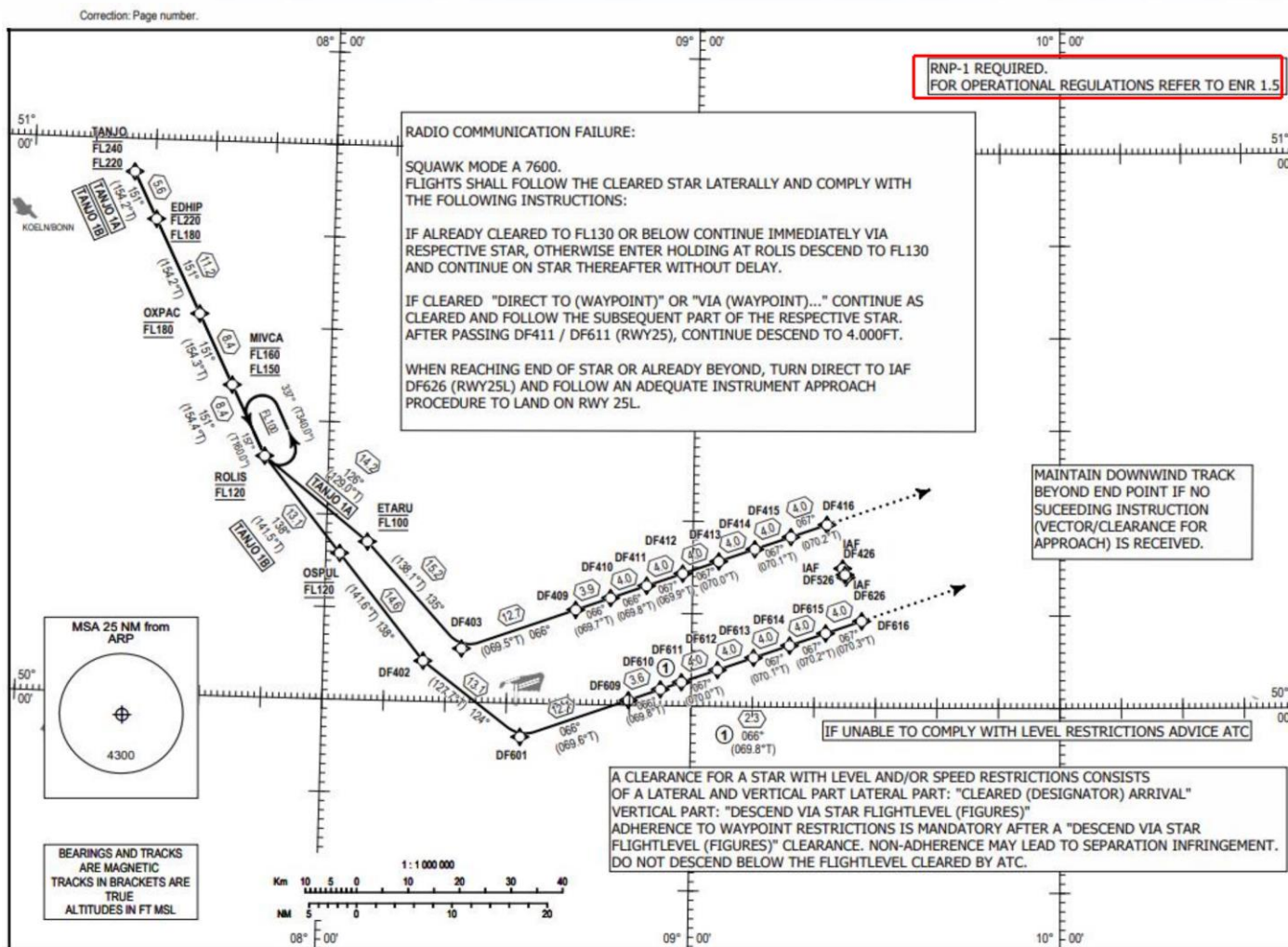
# Merging Method RNAV STAR





# PBN STAR Charts & Coding

# STAR Charts



AD 2 EDDF-3-1-113  
Effective: 02 NOV 2023

FRANKFURT MAIN  
RWY 25L/25C/25R  
TANJO 1A/1B

FRANKFURT ATIS  
LANGEN RADAR  
LANGEN RADAR

TRANSITION  
ALTITUDE 5000  
VAR 3° E

LUFTHANDBUCH DEUTSCHLAND  
AIP GERMANY

STANDARD ARRIVAL  
CHART - INSTRUMENT  
RNP



# STAR Coding

AD 2 EDDF 3-1-116  
Effective: 02 NOV 2023  
FRANKFURT MAIN  
RNP RWY 25L/25C/25R

LUFTFAHRTHANDBUCH DEUTSCHLAND  
AIP GERMANY  
STANDARD INSTRUMENT ARRIVAL ROUTES  
(STAR)

Designator		TANJO 1A TANJO ONE ALPHA											
Procedure Remark													
Route Type	Path Terminator	Waypoint Identifier	Coordinates	Fly-over	(True Track) MAG Track (°)	Distance (NM)	Turn Direction	Altitude (ft) Flight Level	Speed Limit (kt IAS)	Vertical Path Angle (°)	NAV Specification	Remark	
Common	IF	TANJO	N 50 56 25.00 E 007 26 34.00	N	-	-	-	FL240-FL220+	-	-	RNP 1	-	
Common	TF	EDHIP	N 50 51 22.29 E 007 30 25.43	N	(T154.2) 151	5.6	-	FL220-FL180+	-	-	RNP 1	-	
Common	TF	OXPAC	N 50 41 16.40 E 007 38 05.87	N	(T154.2) 151	11.2	-	@FL180	-	-	RNP 1	-	
Common	TF	MIVCA	N 50 33 41.56 E 007 43 49.10	N	(T154.3) 151	8.4	-	FL160-FL150+	-	-	RNP 1	-	
Common	TF	ROLIS	N 50 26 06.37 E 007 49 30.55	N	(T154.4) 151	8.4	-	@FL120	-	-	RNP 1	-	
Common	TF	ETARU	N 50 17 08.00 E 008 06 44.00	N	(T129.0) 126	14.2	-	@FL100	-	-	RNP 1	-	
Common	TF	DF403	N 50 05 48.13 E 008 22 30.06	N	(T138.1) 135	15.2	-	-	-	-	RNP 1	-	
Common	TF	DF409	N 50 10 13.28 E 008 40 59.94	N	(T069.5) 066	12.7	-	-	-	-	RNP 1	-	
Common	TF	DF410	N 50 11 33.83 E 008 46 39.57	N	(T069.7) 066	3.9	-	-	-	-	RNP 1	-	
Common	TF	DF411	N 50 12 56.53 E 008 52 30.83	N	(T069.8) 066	4.0	-	-	-	-	RNP 1	-	
Common	TF	DF412	N 50 14 18.94 E 008 58 22.44	N	(T069.9) 067	4.0	-	-	-	-	RNP 1	-	
Common	TF	DF413	N 50 15 41.04 E 009 04 14.39	N	(T070.0) 067	4.0	-	-	-	-	RNP 1	-	
Common	TF	DF414	N 50 17 02.83 E 009 10 06.68	N	(T070.0) 067	4.0	-	-	-	-	RNP 1	-	
Common	TF	DF415	N 50 18 24.33 E 009 15 59.31	N	(T070.1) 067	4.0	-	-	-	-	RNP 1	-	
Common	TF	DF416	N 50 19 45.52 E 009 21 52.29	N	(T070.2) 067	4.0	-	-	-	-	RNP 1	-	
Runway	IF	DF416	N 50 19 45.52 E 009 21 52.29	N	-	-	-	-	-	-	RNP 1	-	
Runway	FM	DF416	N 50 19 45.52 E 009 21 52.29	N	(T070.2) 067	-	-	-	-	-	RNP 1	-	
Runway	CF	DF426	N 50 15 03.04 E 009 24 30.17	N	(T250.3) 247	-	-	-	-	-	RNP 1	IAF RWY 25R	
Runway	IF	DF416	N 50 19 45.52 E 009 21 52.29	N	-	-	-	-	-	-	RNP 1	-	
Runway	FM	DF416	N 50 19 45.52 E 009 21 52.29	N	(T070.2) 067	-	-	-	-	-	RNP 1	-	
Runway	CF	DF526	N 50 14 21.68 E 009 24 53.24	N	(T250.3) 247	-	-	-	-	-	RNP 1	IAF RWY 25C	
Runway	IF	DF416	N 50 19 45.52 E 009 21 52.29	N	-	-	-	-	-	-	RNP 1	-	
Runway	FM	DF416	N 50 19 45.52 E 009 21 52.29	N	(T070.2) 067	-	-	-	-	-	RNP 1	-	
Runway	CF	DF626	N 50 14 04.23 E 009 25 02.97	N	(T250.3) 247	-	-	-	-	-	RNP 1	IAF RWY 25L	



# PBN SID Concepts

# SID Basic Concepts

- For each runway at aerodromes where instrument departures are expected to be used, a departure procedure **shall** be **established** and **promulgated**.
- A departure procedure should be designed to accommodate all aircraft categories where possible. Where departures are limited to specific categories, the departure chart **shall** clearly identify the applicable categories.
- Departures may be designed as **straight** departures or **turning departures**.
- Procedure design should consider the environmental and efficiency advantages afforded by implementation of a **CCO**(continuous climb operation).

# SID Basic Concepts

When establishing departure procedures, the following aspects should be considered:

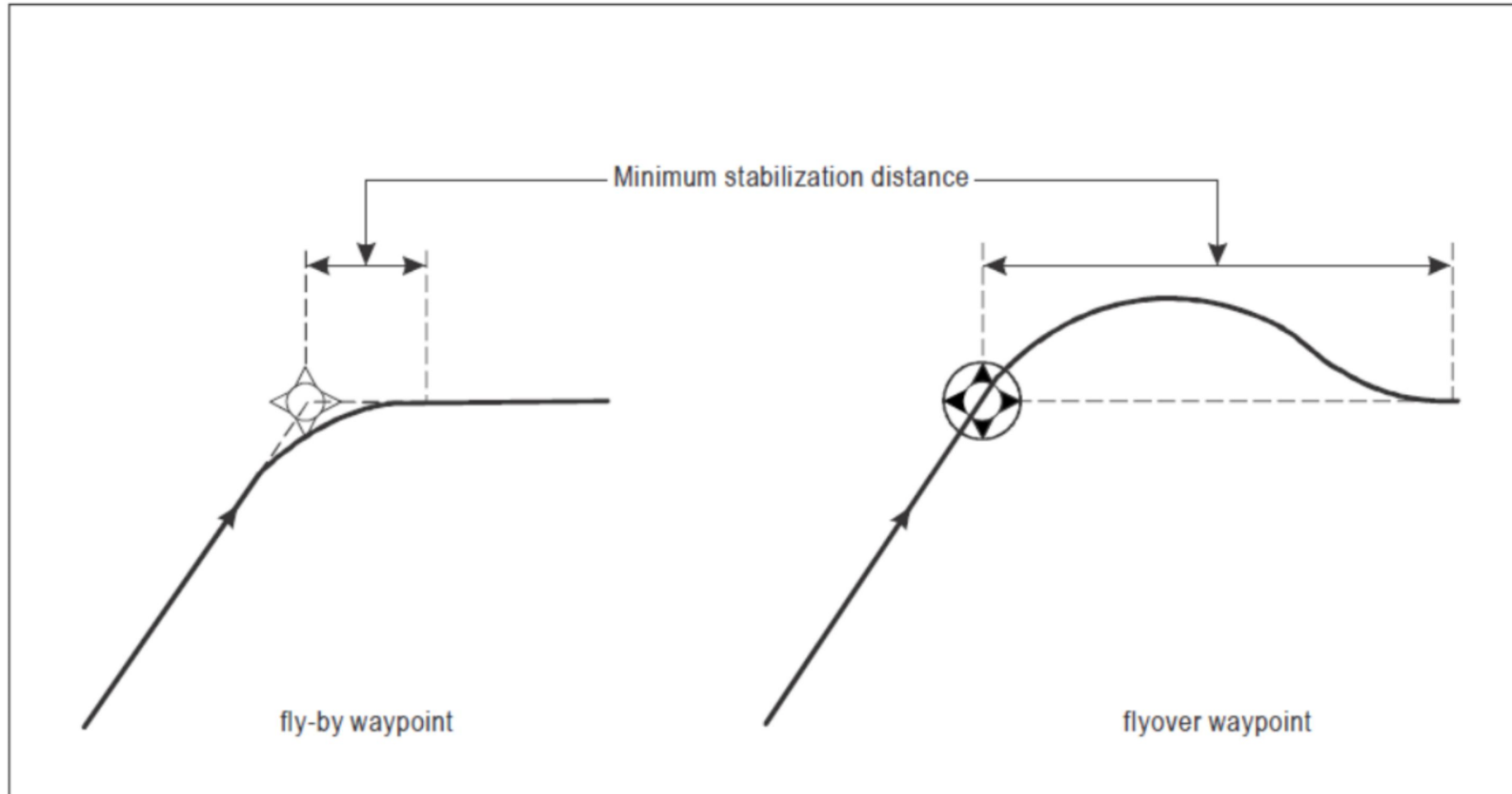
- Safety( Obstacle clearance);
- Air traffic control, airspace management;
- Noise abatement;
- Economy.

# Turning Departures

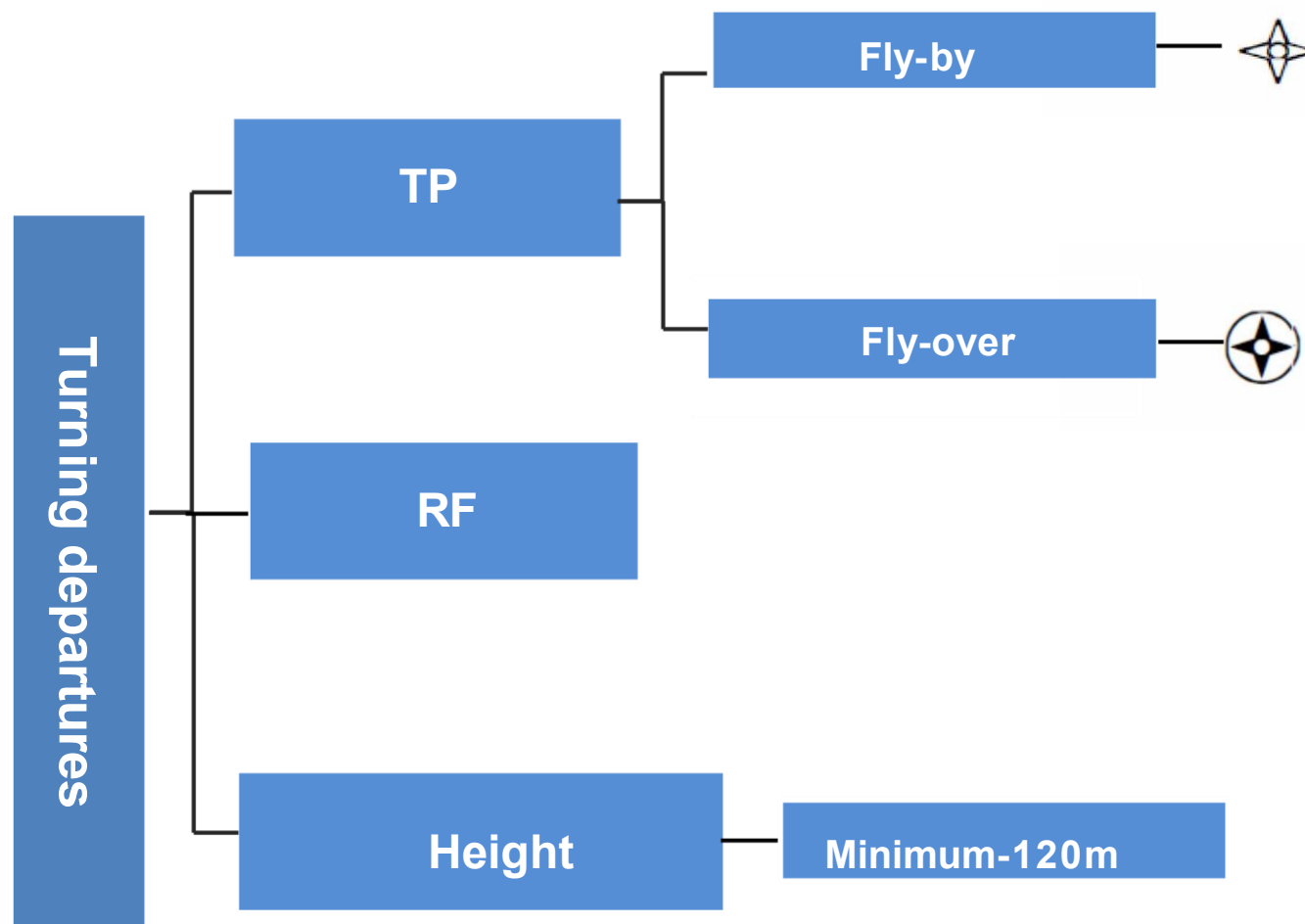
Four kinds of turns can be prescribed in turning departures:

- turn at a “fly-by” waypoint;
- turn at a “fly-over” waypoint(which corresponds to a turn at a designated TP);
- Turn at an altitude/height;
- fixed radius (RF) turns.

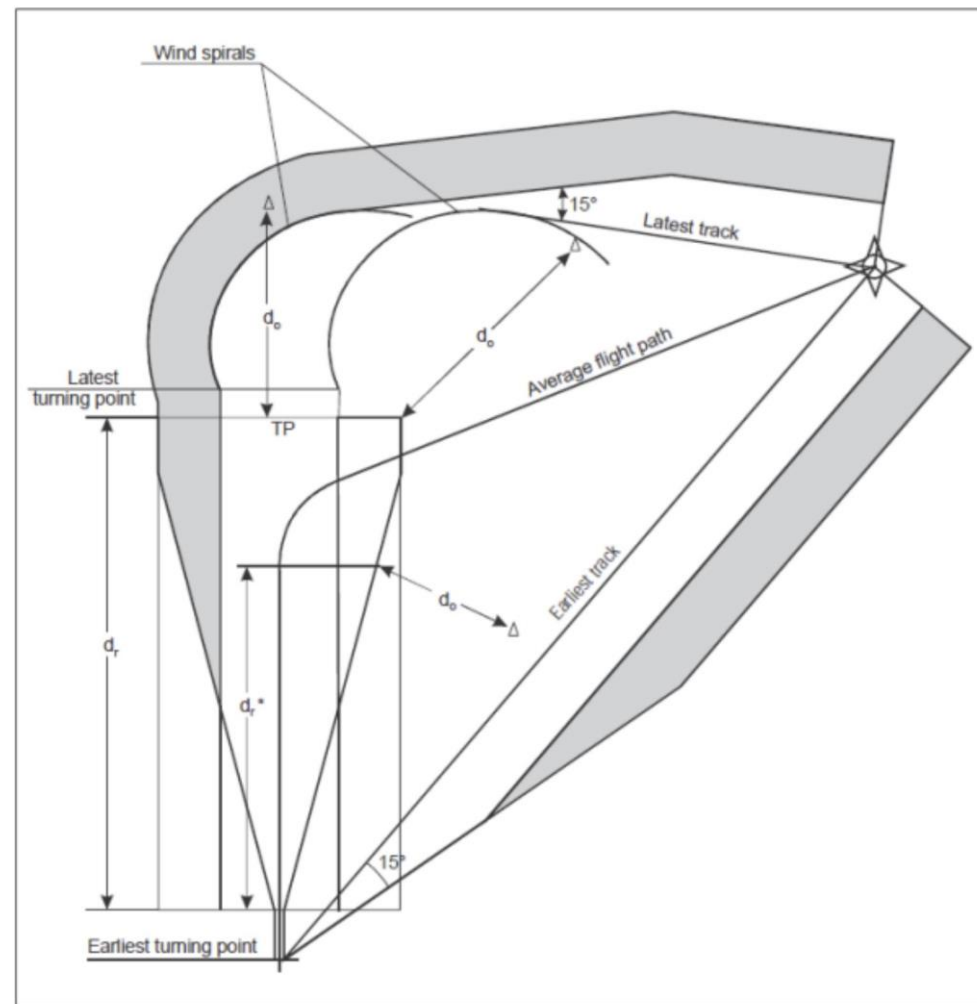
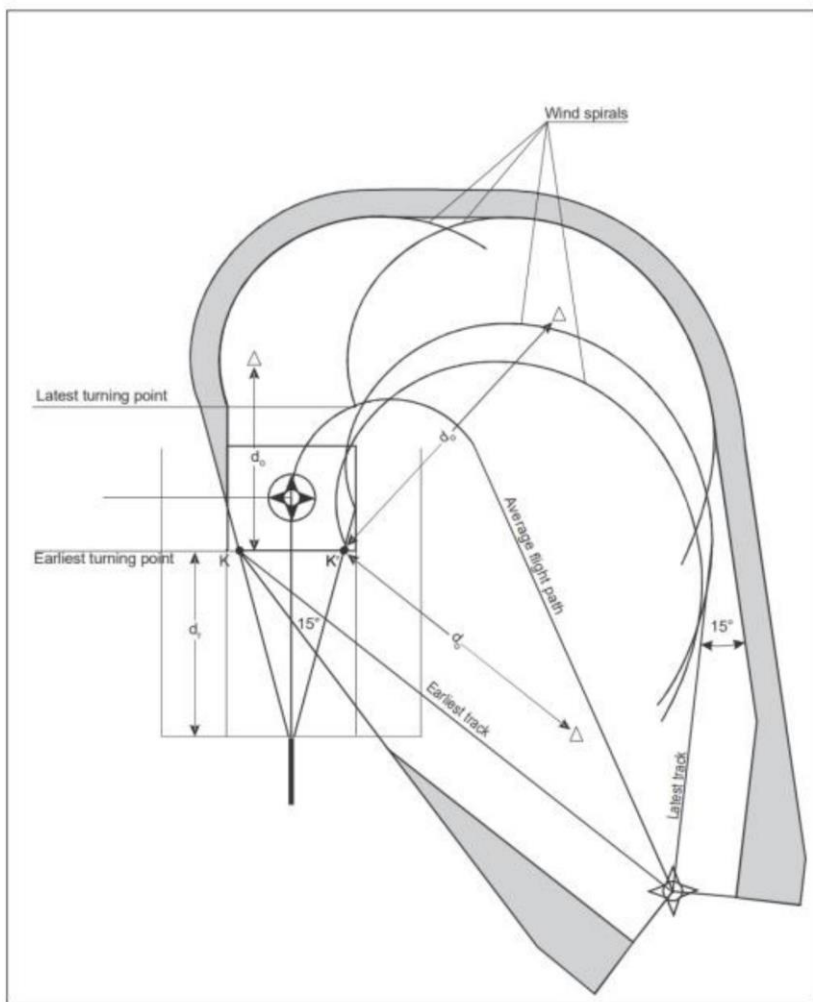
# PBN Waypoints



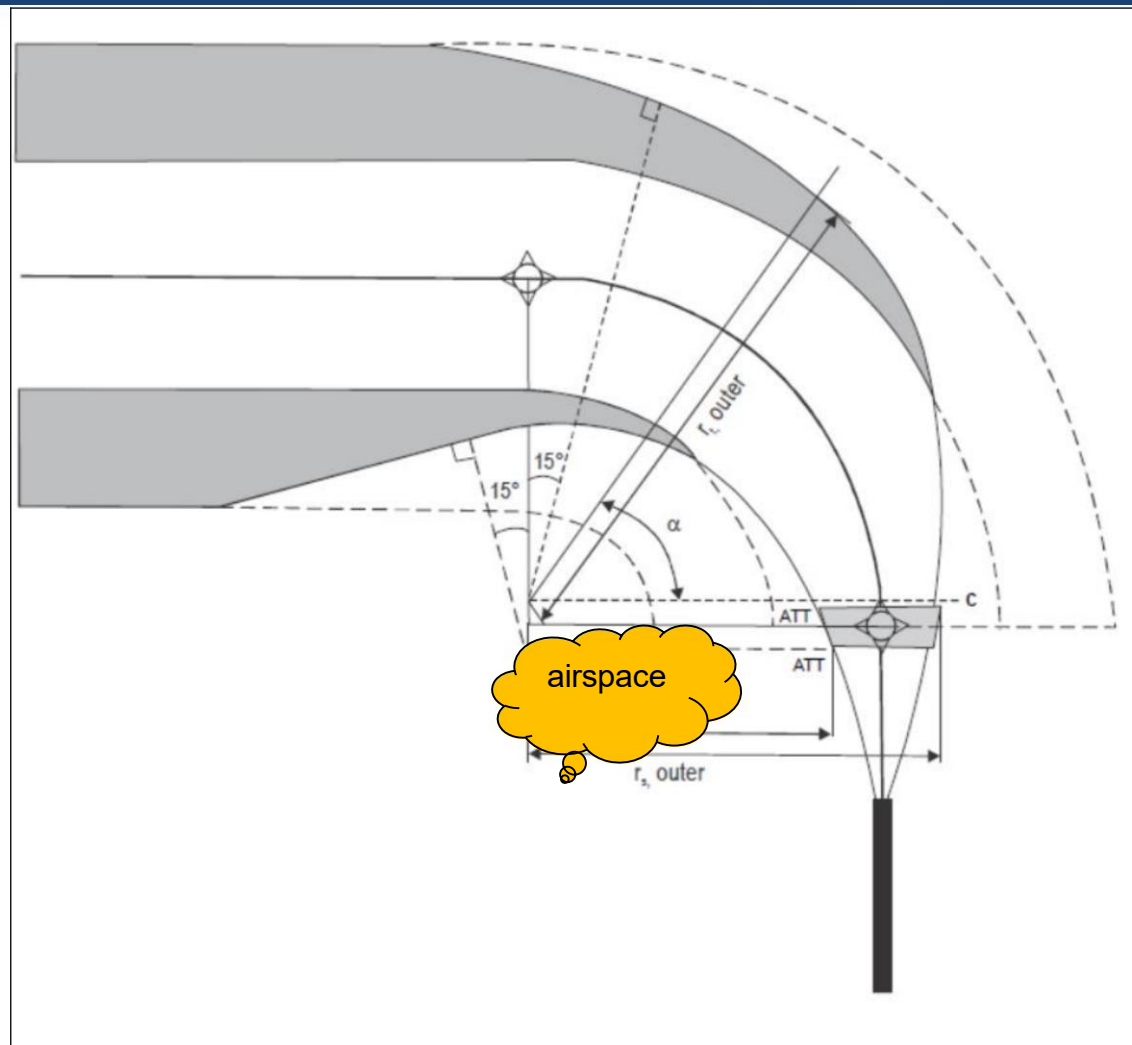
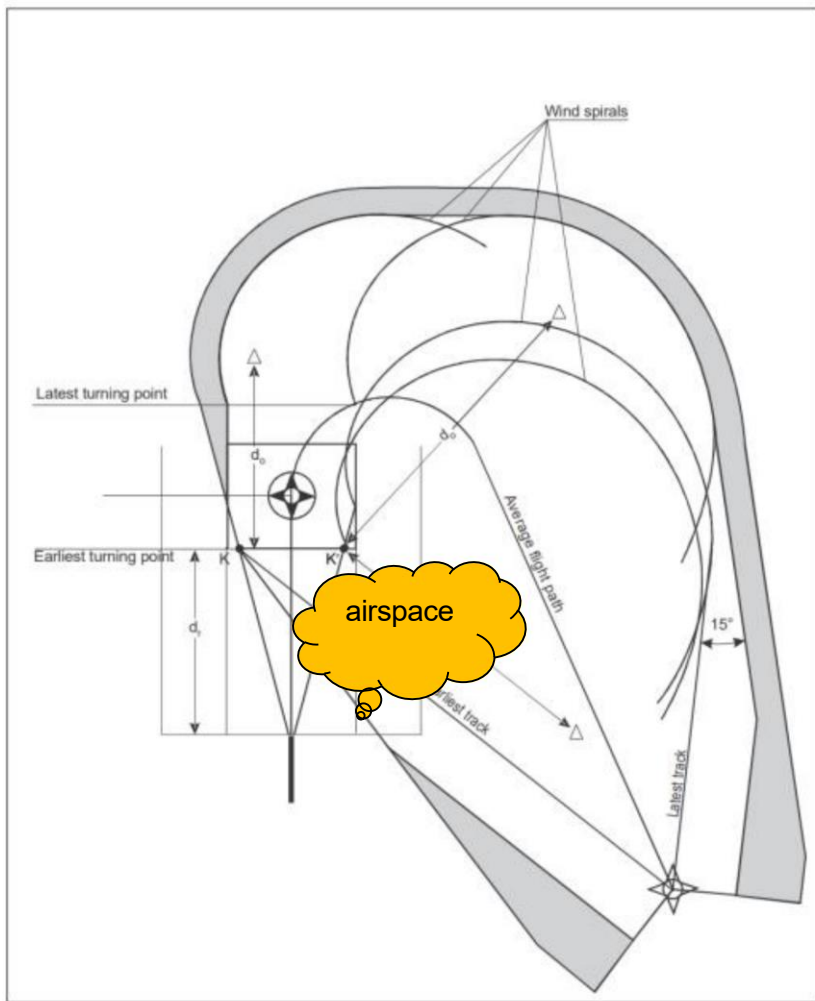
# Turning Departures



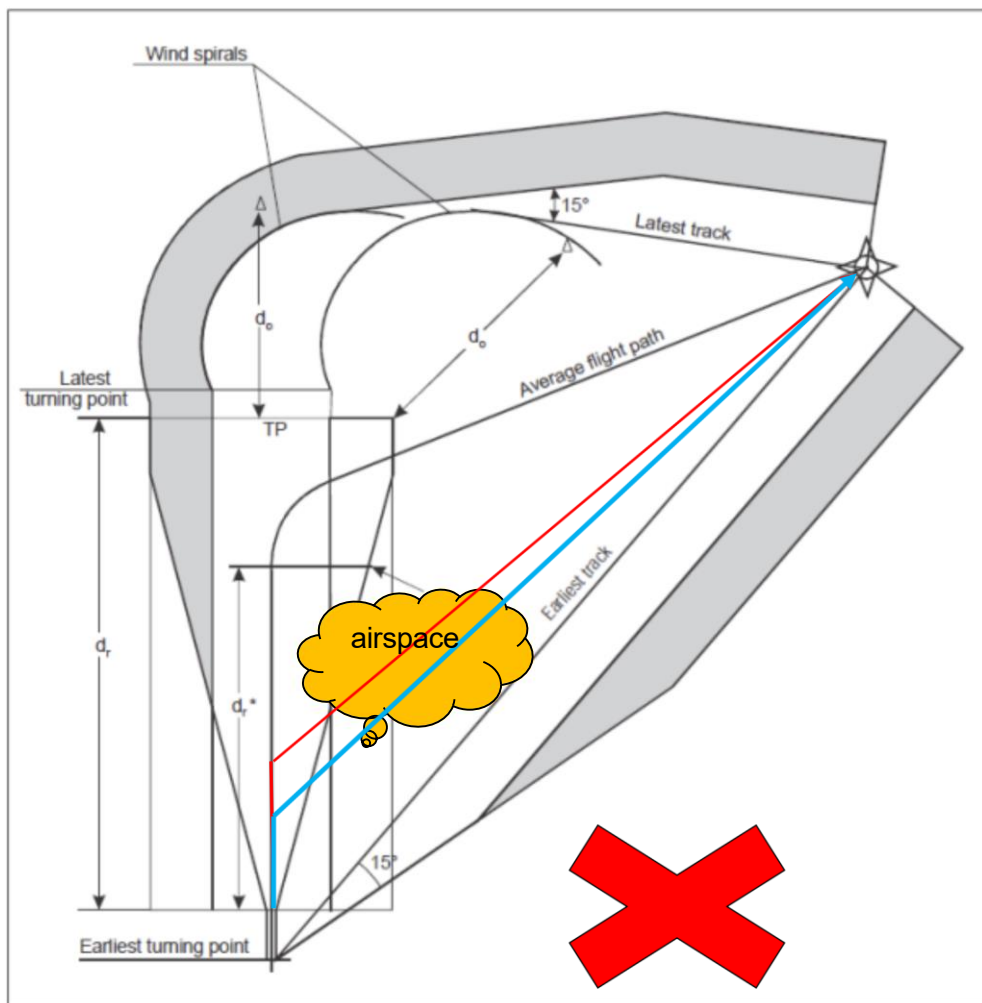
# Turning Departures



# Turning Departures



# Turning Departures

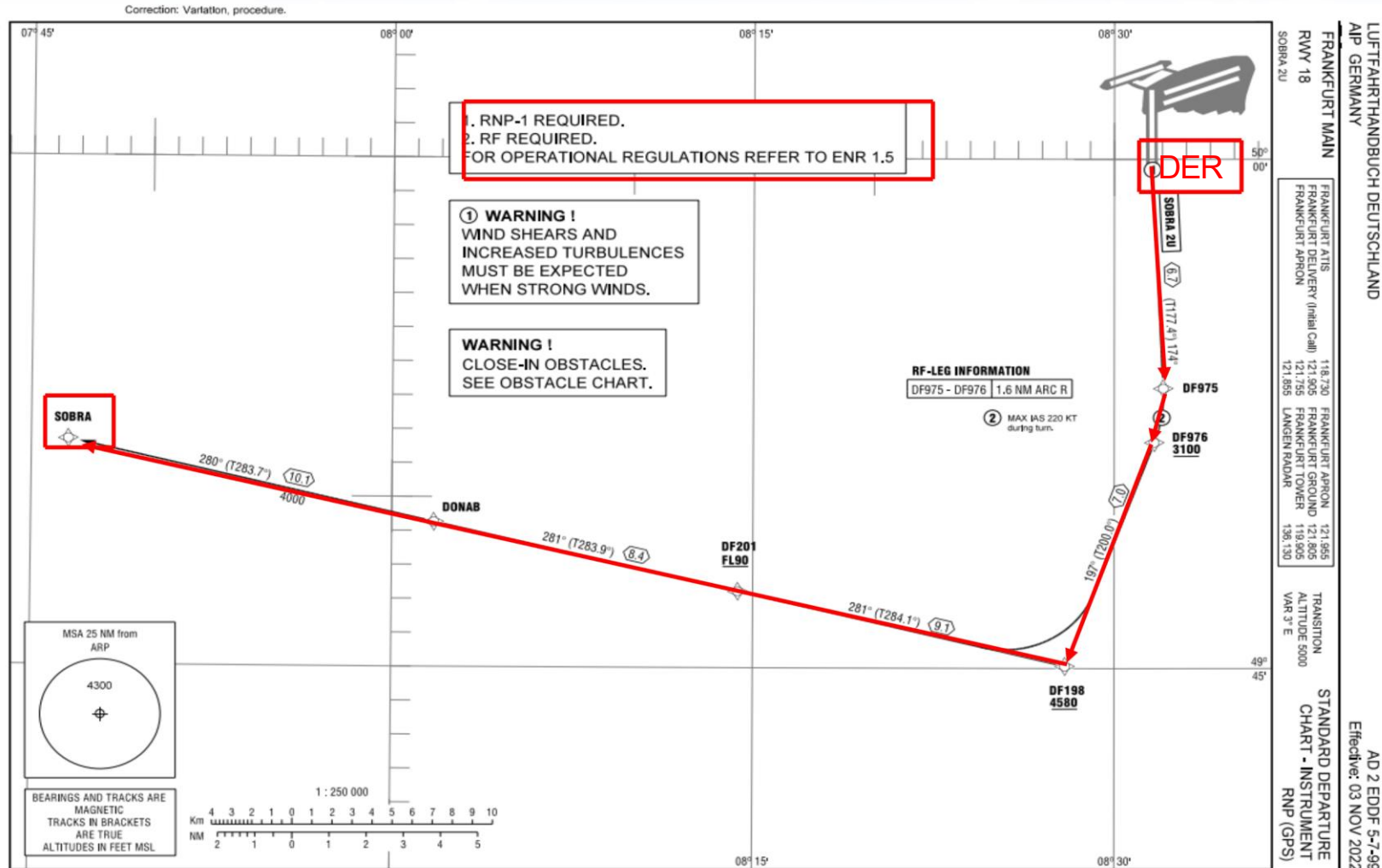


- For the turning procedures at an altitude, the aircraft may turn whenever reaches the turning altitude.
- It's highly possible that the aircraft will enter into the restricted airspace.

# SID Basic Concepts

- The SID procedures **begin** at the departure end of runway (**DER**), which is the end of the area declared suitable for take-off.
- The departure procedures **end** at the point where the route connects to the next segment and the PDG reaches the minimum altitude/height authorized for the next phase of flight. (i.e. en-route, holding or approach).

# SID Basic Concepts





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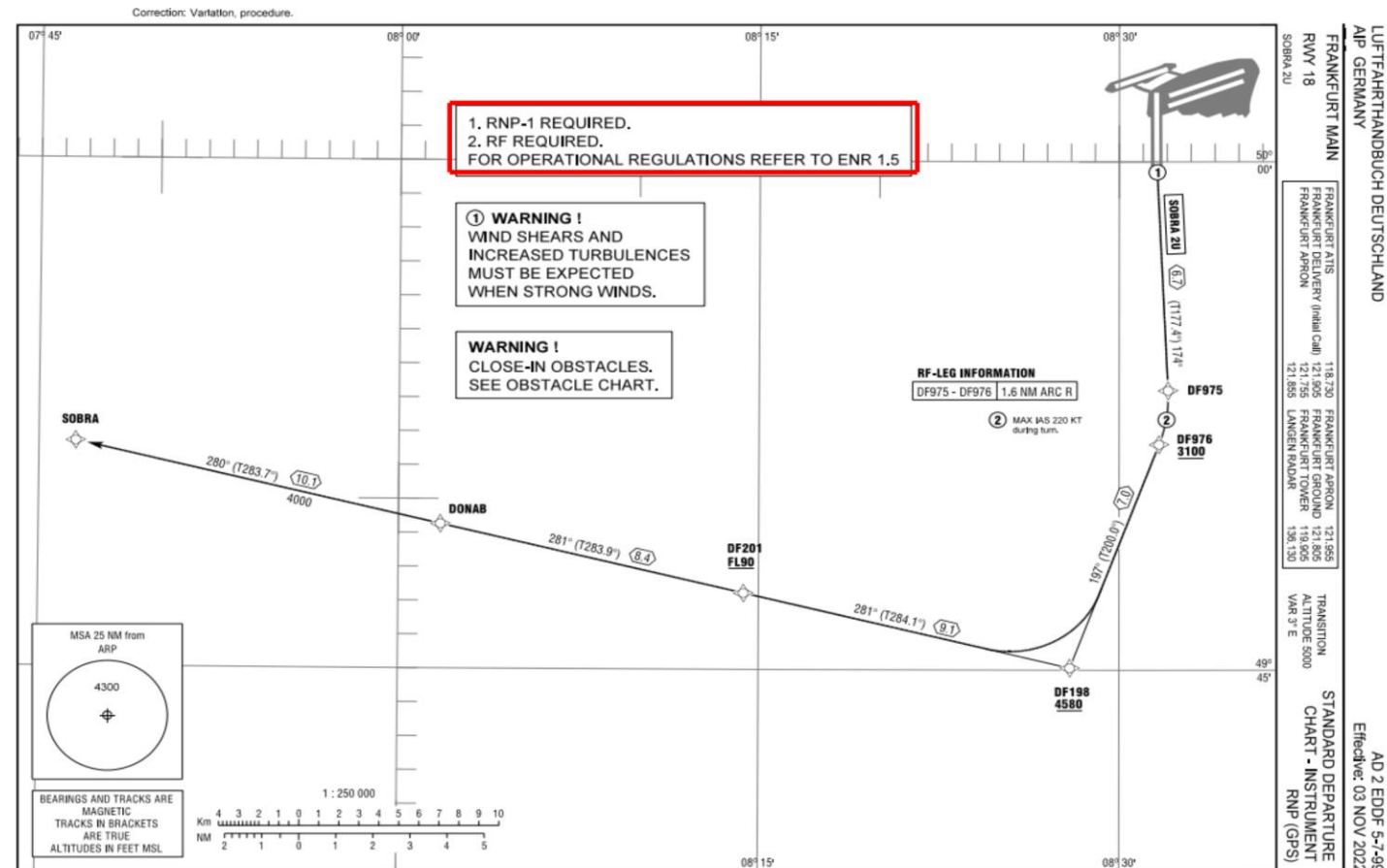


# PBN SID Navigation Specifications

# SID Navigation Specifications

The SID navigation specifications could be used are as follows:

- RNP 1;
- RNAV 1;
- RNAV 2;





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# PBN SID Design Criteria

# SID Design Criteria

The SID basic design criteria are as follows:

- The standard procedure design gradient (**PDG**) is **3.3%**, the PDG begins at a point 5m(16ft) above the departure end of runway(**DER**);
- The standard PDG provides an additional clearance of 0.8% of the distance flown from DER, above an obstacle identification surface(OIS). The OIS has a gradient of 2.5%.
- Where an obstacle penetrates the OIS, a steeper PDG may be promulgated to provide obstacle clearance of 0.8% of the distance flown from DER.
- The design of procedures in accordance with Doc8168 assumes **normal** operations and that **all engines are operating**.



# SID Design Criteria

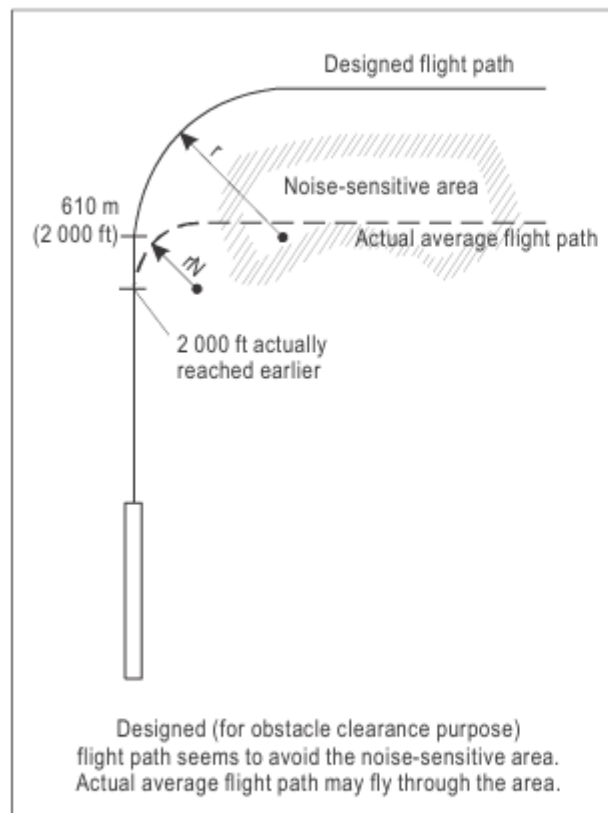
## GUIDANCE MATERIAL ON THE ESTABLISHMENT OF THE AVERAGE FLIGHT PATH OF A DEPARTURE PROCEDURE

For the departure, the desired average flight path to deal with restrictions such as noise or ATC constraints can be drawn according to the speed/distance/bank angle in Table

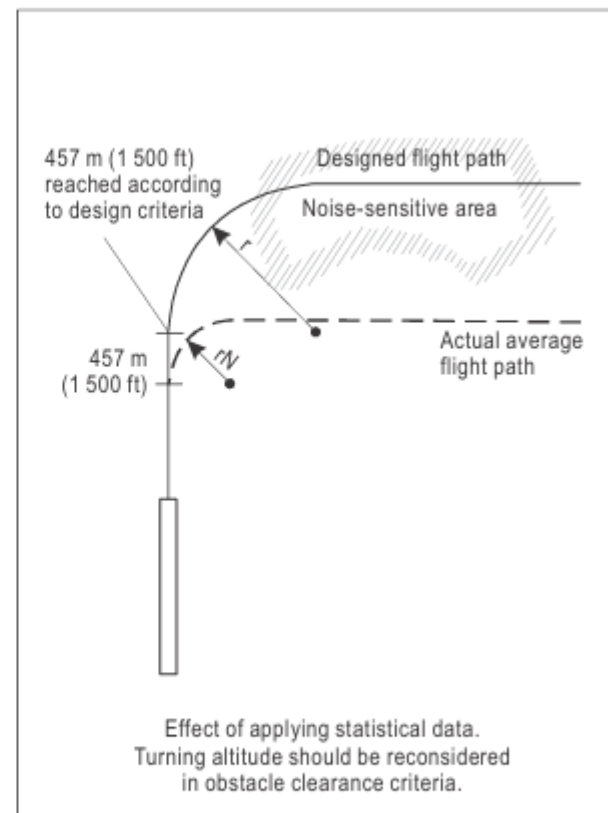
Distance from DER	1.9 (1)	3.7 (2)	5.6 (3)	7.4 (4)	9.3 (5)	11.1 (6)	13 (7)	14.8 (8)	16.7 (9)	18.5 (10)	20.4 (11)	22.2 (12)	24.1 (13)	25.9 (14)	27.8 (15)	29.6 (16)	31.5 (17)	33.3 (18)	35.2 (19)	37 (20)	38.9 (21)	40.7 (22)	42.6 (23)	44.4 (24)	46.3 (25)
Height above rwy	130 (425)	259 (850)	389 (1 275)	518 (1 700)	648 (2 125)	777 (2 550)	907 (2 976)	1037 (3 401)	1167 (3 827)	1296 (4 252)	1476 (4 677)	1556 (5 103)	1685 (5 528)	1815 (5 953)	1945 (6 379)	2074 (6 804)	2204 (7 229)	2334 (7 655)	2463 (8 080)	2593 (8 505)	2723 (8 931)	2892 (9 356)	2982 (9 781)	3112 (10 207)	3241 (10 632)
Bank angle	15	15	20	20	20	20	20	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Speed	356 (192)	370 (200)	387 (209)	404 (218)	424 (229)	441 (238)	452 (244)	459 (248)	467 (252)	472 (255)	478 (258)	483 (261)	487 (263)	491 (265)	493 (266)	494 (267)	498 (269)	502 (271)	504 (272)	511 (276)	515 (278)	519 (280)	524 (283)	526 (284)	530 (286)

# SID Design Criteria

## GUIDANCE MATERIAL ON THE ESTABLISHMENT OF THE AVERAGE FLIGHT PATH OF A DEPARTURE PROCEDURE

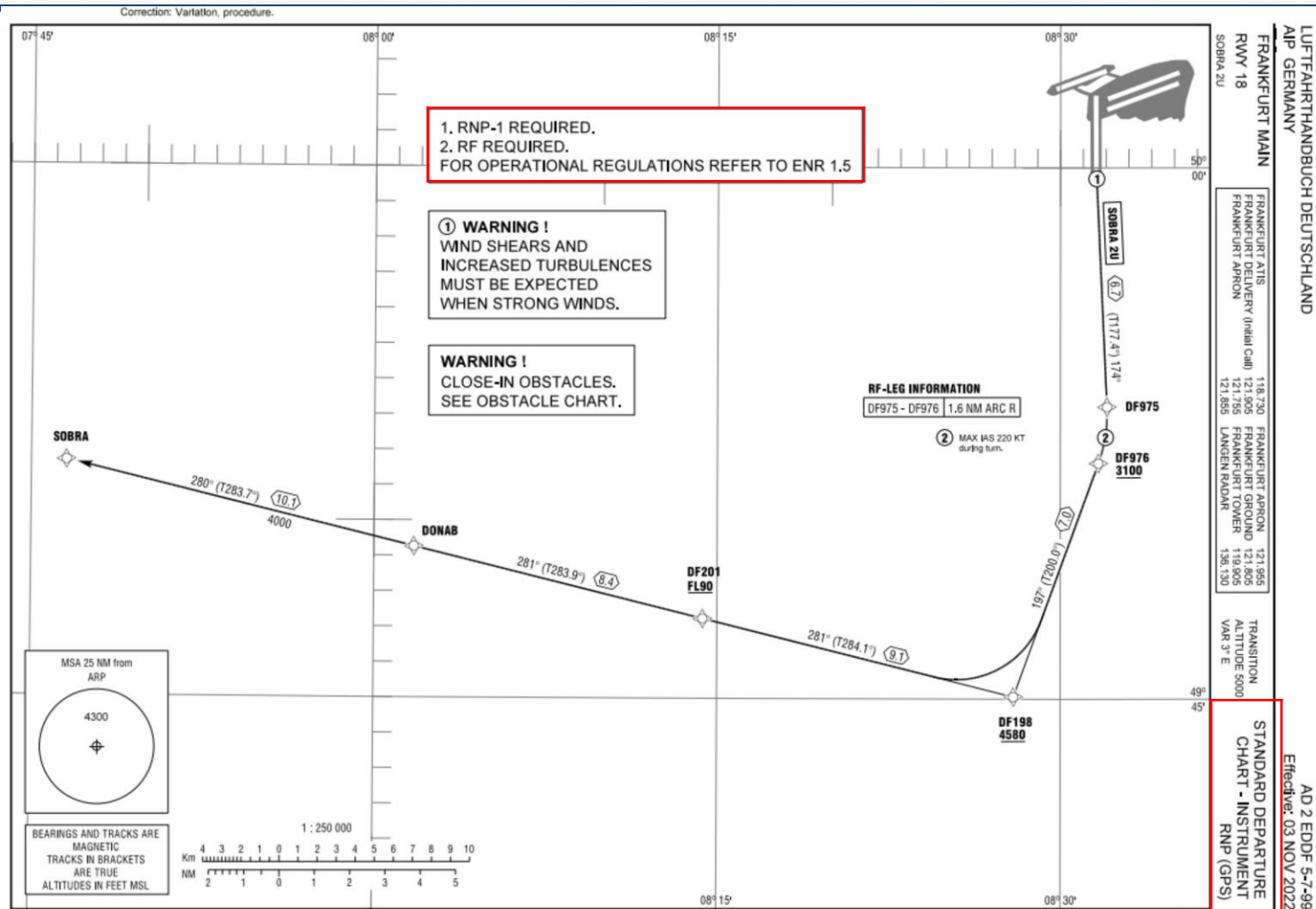


**Figure I-3-3-App-1. Turn at a designated turning altitude — procedure without application of statistical data**



**Figure I-3-3-App-2. Turn at a designated turning altitude — procedure with application of statistical data**

# SID Charts



# SID Charts

FRANKFURT MAIN  
RWY 18  
UNIFORM

STANDARD DEPARTURE  
ROUTES - INSTRUMENT (SID)  
RNP (GPS)

Designator	Route			After Take-Off				Remarks Text Page		
				Climb to	Contact					
<b>SOBRA 2U</b>	<b>SOBRA TWO UNIFORM</b> To DF975 on course 174°. Turn right with 4.15 NM radius to DF976, at or above 3100, maximum speed 220 kts. To DF198, at or above 4580. To DF201 at or above FL90. To DONAB. To SOBRA.			4000 ft	Langen Radar 136.130 Contact Langen Radar when advised by Tower!  (Departure frequency may deviate from the frequency published. Check ATIS for current departure frequency.)			1. If unable to pass DF201 at or above FL90, advise EDDF DELIVERY prior to start-up and expect routing via SID ULKIG L. 2. For flights intending to proceed at or above FL 250 via Y180/Y181. Flights have to be able to cross RUDOT at or above FL 240. If unable to comply, flight plan shall read RUDOT FL 220 - Y180 - NISIV - UY180 - DIK RFL. 3. Do not turn before DER.		
Recommended Path Terminator	Waypoint Identifier	Coordinates	Fly Over	(True Track°) Mag Track°	Distance (NM)	Turn Direction	Altitude (ft) / Flight Level	Speed Limit (kt IAS)	NAV-Specification	Remarks
CF	DF975	N 49 53 14.87 E 008 32 02.38	-	(T177.4) 174	6.7	-	-	-	RNP-1 RF required	-
RF	DF976	N 49 51 39.29 E 008 31 39.92	-	-	1.6	R	A3100+	220-		ARC Center: DF977 N 49 53 03.56 E 008 25 37.60 ARC Radius: 4.15 NM
TF	DF198	N 49 45 03.68 E 008 27 57.13	-	(T200.1) 197	7.0	-	A4580+	-		-
TF	DF201	N 49 47 15.18 E 008 14 22.30	-	(T284.1) 281	9.1	-	FL90+	-		-
TF	DONAB	N 49 49 15.89 E 008 01 44.83	-	(T283.9) 281	8.4	-	-	-		-
TF	SOBRA	N 49 51 39.00 E 007 46 32.00	-	(T283.7) 280	10.1	-	-	-		-

# Q&A?

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Eastern and  
Southern African  
(ESAF) Office  
Nairobi

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Bangkok

ICAO Asia Pacific Flight Procedure  
Programme (APAC FPP)

Co-located with ICAO APAC Regional  
Sub Office (RSO) in Beijing China

Let's **F**ocus/**P**ropose/**P**lan  
Together